Accident Analysis and Problem Identification

COURSE OUTLINE

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INTRODUCTION

This accident prevention technique asks each of us to draw on insights about mines and mine accidents derived from years of experience as miners, supervisors, and safety personnel.

The technique suggests utilizing those insights with a practical based approach for the analysis of a mine's accident to determine what options are available to prevent injuries.

A different perspective is called for at the outset. Gone is the "brush fire" mentality which assumes that each accident is unique and exists in a vacuum. Gone is the thinking which separates accidents into neat classifications, e.g., electrical, roof fall, haulage. These traditional methods are replaced by a perspective which calls for "a way of thinking" generated by the awareness that accidents are not "the problem" but instead are the symptoms of a mine's problems.

This technique proposes the application of the years of field experience we have to the examination of a specific set of variables common to all accidents. Within this analysis lie the questions and ultimately the answers to the greater question, "What options are available to prevent injuries?"

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Review of Course Content

The purpose of this course is to provide you with a method which can help you to pinpoint the causes of accidents and develop solutions tailored to a particular mine. Our goal is to be able to produce sound recommendations which are supported by and logically derived from information on the mine. We will proceed through this course, step by step to show you how to make a strong case which consists of being able to tell an operator -

What is causing problems at the mine

What the problems are

What kinds of accidents are resulting from those problems

What actions can be taken to eliminate or alleviate those causes and therefore reduce the problems and accidents

This is what we will cover.

1. We will first give you a conceptual overview. We believe it's important that you have an understanding of why we put the parts of the course together like we did. If you have a conceptual understanding of the technique we re offering, the tools which we will be showing you how to use and the results from their use should be more meaningful.

   We will also discuss the "customizing" approach to addressing accident prevention and reduction. We will suggest to you that it is cheaper and more effective to use a rifle rather than a shotgun approach to eliminate accidents.

   The technique we will be presenting can best be described as occurring in three stages. Activities which occur before going to the mine site, activities at the mine site and activities that are carried out when mine site activities are completed.

2. As you can see from the course outline, there are three activities done before going to the mine site. The preliminary data analysis covers some methods for rapidly screening accident data. We will be using two tools, Physical Barrier Analysis and Human Barrier Analysis, to screen the data. Since these tools are the foundation of the technique we will spend quite a bit of time discussing and using these tools.

   We will then interpret the results of the Physical and Human Barrier Analysis to come up with the potential causes of the accident patterns we have discovered. The potential causes lead us to developing a planned inquiry, questions to ask, areas to observe, in order to carry out a more systematic investigation at the mine. The planned inquiry helps us to narrow our investigations to specific aspects of the total mining operation rather than having to look at the entire operation.

   The final activity in this stage is a discussion of the factors necessary to insure the cooperation of MSHA, mine management and labor in carrying out the on-site activities. A well planned and executed initial notification and meeting can provide a positive foundation on which all subsequent on-site activities can be built.

3. In the next stage we cover what we want to do at the mine. This is a data gathering step. Activities at the mine concern problem identification through interviewing and observation. The purpose is to point out that the interviewing and observations must be dynamic rather than static; that it is necessary to go where the data leads rather than rigidly following a predetermined set of observations and asking a static set of questions.

4. The third stage, which covers activities required after returning from the mine, is entirely organizational. The purpose is to demonstrate how to put all the data together to form a logical sequence which support our recommendations. We have gathered a lot of information and we need to be able to interpret it and put it together so we can answer:

What is causing problems at the mine

What the problems are

What kinds of accidents are resulting from those problems

What action can be taken to eliminate or alleviate those causes and therefore reduce the problems and accidents

Those answers are our bottom line!

Conceptual Overview

Logic of the Technique

As we have indicated before, we think it's a good idea if you have some understanding of the logic behind the technique we are discussing. We think it will give you a better understanding of how everything fits together and how the tools you will be given can help you to answer these four important questions:

What is causing problems at the mine

What the problems are

What kinds of accidents are resulting from those problems

What action can be taken to eliminate or alleviate those causes and therefore reduce the problems and accidents

If I'm feeling ill, I may decide that rather than take matters into my own hands, I'll go to see a doctor. This is especially true if I treated myself and got no results. What do I expect from the doctor? While I might be interested in finding out what's wrong with me, I want to know what I have to do to get rid of what I got. Furthermore, I expect that the recommendation the doctor makes will produce results.

Final Product --- "Recommendations which can lead to results."

When I go to the doctor, I'm asked what's wrong. Of course if I knew, I wouldn't be there. What I am able to describe are my symptoms.

1. Symptoms - runny nose, headache, watering eyes and sensation of extreme heat.

With this limited information and maybe a few more questions, the doctor will come up with some potential causes. What the doctor has done here is a very important step. From the symptoms, he has narrowed the list of potential causes. He knows that if he is to get the results I want, he must find the correct cause and treat it. He certainly cannot treat all the potential causes, since each must be treated differently and to treat all would be a waste of my resources and could be counterproductive.

2. Potential causes - bacterial or viral infection or allergic reaction.

Now that the doctor has an idea of the potential causes he can begin a search for problems that will lead him to the real cause. He will do this by gathering more data, but because he has some idea of the potential cause he will be able to carry out a more focused and systematic search. He will give me a blood test, but not a chest x-ray, a test for allergy, but not a CAT scan.

3. Discovery of the problems which identify the cause.

Once the cause is determined the doctor can then make recommendations, which, if I follow them, should cure or alleviate my problems and symptoms. We have completed the cycle.

4. Recommendations which can lead to results.

The technique we will present considers accident prevention and reduction as requiring the same sort of analysis as the one described in our over-simplified medical example.

Rather than having symptoms, we have accidents which have occurred or, if really lucky, data on near misses. These accidents result from some underlying causes not readily apparent without more in-depth investigation. Just as the doctor started with the symptoms to help narrow down the causes, we use accidents as our starting point. Our analysis of the accidents will lead us into potential causes.

Once we have narrowed down our causes, we can more systematically search for problems resulting from the causes. This discovery of the problem takes place at the mine. But rather than look at everything we could possibly look at, we can now focus our search at the mine. Just like the doctor - we are gathering more specific information.

Having discovered the problems that exist, we can now define the cause. Just like the doctor, at this point we can recommend action directed at eliminating or alleviating the cause(s). And, just like the doctor, we want to be sure that our recommendations, if implemented, can lead to results. Because we are dealing with the behavior of humans, and our data is often softer than that in our medical analogy, we want our recommendations rigorously supported by the data, and a logical outgrowth of our analyses.

The doctor can say, "You have an allergy that has caused an increased level of histamine which has resulted in a headache, runny nose, etc. Now take this drug if you want relief." Similarly, our analysis can produce a product which says, "Here is what is causing problems at your mine. These are the problems and these are the accidents that are resulting from these problems. If you take this action, you can impact those causes and improve safety in your operation." How to accomplish this is what the course is about.

Conceptual Overview

Customizing Solutions

When spring comes and we have to begin taking care of our lawns again, most of us will notice all kinds of new green plants in the yard. These plants are definitely not in the grass family and are not actually plants we desire to have in our yards. If the problem is not too severe, we may ignore it. However, if we ignore the problem, we begin to notice more and more of the green things and less and less grass. We are finally forced to act when, four days after mowing, the weeds are 7" high and the grass only 3" high.

There are two basic approaches to getting rid of the weeds:

1. We can dig out the weeds, one at a time, or

2. We can attack them all at once with a general approach such as a herbicide.

Anyone who has tried the first approach knows what happened. Because we never get all the roots, the weeds grow back.

That leaves us with the second approach. We have two options:

1. We can purchase herbicides, try them, and if they kill the weeds, fine. If they don't, we try different herbicides until we find one that attacks the types of weeds we have or we give up, surrender.

2. We can identify the particular plants that are the problem, select the herbicides developed for that plant and apply it as per the directions.

Anyone who has tried the blind purchase of herbicide also knows what happens. Not only do weeds go, but so do other desirable plants, like the flowers. We also find ourselves spending more money than we wanted to for the weed killers, and our storage areas become more pressed for space.

Mine accidents have some fundamental similarities to the weeds in our yard.

1. There are many different types of accidents.

2. While they may not be too frequent or severe, if we ignore them, things usually get worse.

3. All the accidents can't be prevented by the same methods.

The quickest and least expensive way to eliminate the weeds was to identify them first, then select the appropriate action to eliminate them and finally implement the action as directed.

What would be the quickest and least expensive way to eliminate accidents? If we generalize from our weed example, we would:

identify groups of accidents which lend themselves to the same preventive measures,

determine **causes** for lack of those measures,

select appropriate methods to **eliminate** those causes, and finally,

implement those methods.

Does training prevent accidents? Of course!

Does engineering prevent accidents? You bet!

Does inspection prevent accidents? Sure!

Does any one of the three methods eliminate the causes of all accidents? Of course not. Each method reduces only the accidents which were caused by a lack of it.

Many times an accident prevention program is implemented that does a good job of reducing a certain type of accident. Just like a herbicide doesn't kill all weeds, no one accident prevention technique can prevent or reduce all accidents.

We want an accident prevention program that is customized to attack the accidents at a particular mine. If we want to be effective and efficient, we must apply remedies which will eliminate the specific causes of accidents. To do this we must first identify and understand as much as we can about the causes of accidents. Once we do this we can customize the program.

Preliminary Data Analysis

I. Introduction

The first step in most traditional accident prevention programs has been looking at information to determine where the mine appears to be having problems. Collecting and analyzing data as a first step in finding out what's going on makes such good sense that we also begin at this point. Because this activity prepares us for the main course of business, we call this procedure a Preliminary Data Analysis (PDA). We will introduce two highly structured techniques for performing this analysis: the Physical Barrier Analysis (PBA) and the Human Barrier Analysis (HBA).

The presentation of these techniques results in two distinct considerations:

1. The thought process or "way of thinking" about the data to get usable information from it.

2. The mechanics of documenting the results of that thinking in the form of organizers, tally sheets, etc.

The first concern, thinking about accidents, is a critical step in the analysis of accidents at any mine, be it large or small, with many or few accidents.

The second concern, staying organized while working with large amounts of data, results in the use of several recording aids to keep track of the products of various phases of the analysis. At a mine with large numbers of accidents these tools, forms, aids are a necessary part of the analysis process. At a mine with few accidents where the amount of data to be analyzed is not so overwhelming, these organizing aids are probably not necessary.

You can use the PBA and HBA tools as appropriate, but the use of Physical and Human Barriers conceptually will provide you with a different perspective on accident causes and their solutions.

The PDA, using this different perspective helps us to:

1. Identify the types of accidents as a function of how they can be prevented.

2. Begin to understand what may be causing absence of or deficiencies in these preventive measures.

From this perspective we can say that mine accidents fall into one of two types:

1. Accidents which could have been prevented by some type of physical barrier.

2. Accidents which could have been prevented by the individuals involved.

Mines differ with respect to numbers of accidents, specific contributors to accidents and the relative magnitude of the HUMAN vs. the PHYSICAL condition problem. Each of the accidents at any given mine is a manifestation of either a HUMAN or PHYSICAL problem.

The Preliminary Data Analysis separates accidents into the two types, establishes the magnitude of each, and begins to clarify the causes. Our analysis reverses the normal method of looking at accidents. We determine the cause by first determining how the accident could have been prevented.

II. Swimming Pool Analogy

I have a two year old child. My neighbor owns a swimming pool.

1. Is this a recipe for an accident?
2. How can my neighbor and I prevent it?

Most likely our list will include some of the following:

1. Teach the child to swim.
2. Put a fence around the pool.
3. Put a leash on the child.
4. Punish the child for going near the pool.
5. Supervise the child closely.
6. Move.
7. Fill in the pool.
8. Cover the pool.
9. Drain the pool.
10. Make the salt concentration of the water so high the child would float.
11. Put a life preserver on the child.

As we can see from the list, our solutions fall into two general types. Either a physical change has been suggested (2, 3, 5, 6, 7, 8, 9, 10, 11) or we have suggested making a change in the child (1, 4). Accidents at the mine can be prevented in the same two general ways - **change the physical environment** or **change the person.**

Physical environments can be changed by bolting, cutting, welding, etc.

People can be changed by altering factors which shape their behavior, their knowledge, skill, understanding, etc.

Physical Barrier Analysis (PBA)

Mr. David Zegeer, Assistant Secretary of the Mine Safety and Health Administration, has said a well engineered mine is the foundation for a safe mine. To us this means that the appropriate physical barriers are in place and functional. The PBA takes a quick look at the potential for improved engineering at a mine.

It is reasonable to assume that some mines make better use of barriers to prevent accidents than others. Our primary interest is to determine the extent to which a particular mine is using these preventive measures and how much of their accident problem can be attributed to the lack of their utilization.

Barriers prevent the release of unwanted energy, reduce its forcefulness, or prevent the energy from contacting the individual. If the barrier is adequate, the individual should not be injured and thus no accident would occur. There are four classes of barriers which can be used singly or in combination.

I. Barriers on the energy source:

The primary purpose is to prevent the release of unwanted energy.

xample: A roof may be bolted or supported; a vehicle can have brakes or speed control.

II. Barriers between the person and the energy source:

The primary purpose is to prevent unwanted energy from contacting the person.

Example: Guards on moving parts of equipment; a shield between a welder and other workers.

III. Barriers on the person:

The primary purpose is to reduce the forcefulness of the unwanted energy.

Example: Goggles; hard toe shoes; self-contained breathing apparatus.

IV. Barriers that separate the person from the unwanted energy by time or space:

The primary purpose is to prevent the unwanted energy from contacting the person.

Example: Removing all persons from blasting areas (space barrier). Re-entry to blasting area at such time as concentrations of smoke, dust, or fumes have been reduced to safe limits (time barrier).

We can see that some of the barriers are not clear cut. Barriers on the person could very easily prevent the unwanted energy from contacting the person. Thus, goggles will keep objects out of a person's eyes. But if the object has any force behind it, it could break the goggles. However, the amount of damage to the eye should be less as a result of the amount of impact the goggle has absorbed.

Barriers on the person can also be distinguished from barriers between the person and the energy source, if we consider the former as being extensions of the person. Gloves are extensions of the hands and skin, goggles are extensions of the eyes. This is in contrast to a guard or fence which are not extensions of the person and protect more parts of the body. Any personal protective equipment is a barrier on the person.

A more difficult discrimination exists between barriers between the person and the energy source and barriers that separate the person from the energy by time or space. The latter is in fact a special case of the former. When we think of barriers between the person and energy source, we are thinking of barriers that are constructed of some substance; they are engineered for the purpose of separating the person and the energy source.

Time and distance are always present and become used as a barrier, often based on someone's judgment. Since time and space are always present, it is easy to make them into barriers. In order to clarify what we mean by a time or space barrier, we have imposed an additional criterion. A time or space barrier must be based on a written policy or must signal that the time or space barrier is in effect. This criterion limits the person's judgment. The signal or policy tells the person what the appropriate response should be. For example:

> I see some men breaking rocks with a hammer. If I need to get by the group, I can wait until they stop hammering, take a route that will put me out of range of any flying rock or take my chances and walk right by hoping no rock will be flying. Whatever my choice, I have made it based on my judgment. While a time or space barrier was appropriate, it was not defined by signal or policy.

Contrast that example with the following examples:

> 75.1403-7
>
> a. Mantrips should be operated independently of any loaded trip, empty trip or supply trip and should not be operated within 300 feet of any trip, including another mantrip.
>
> i. Explosives and detonators should not be permitted on any mantrip or hauled within five minutes before or after any mantrip.

These examples are examples of space and time barriers established by regulation. No room is left for individual judgment concerning either time or space.

When using the Physical Barrier Analysis, the latter examples describe the time or space barrier. Both time or space barriers are independently determined so that no judgment of what the proper time or space should be is left up to the person making the response.

DOING A PHYSICAL BARRIER ANALYSIS

Our Physical Barrier Analysis (PBA) is based on four assumptions:

I. There are four types of physical barriers. When a physical intervention can prevent an accident, that intervention will always be one or a combination of the four types of physical barriers.

II. Accidents which were not caused by the lack of a physical barrier cannot be prevented by introducing one.

III. Being able to identify accidents a physical barrier could have prevented, and accidents a physical barrier could not have prevented, allows us to fit remedies to the causes of accidents more accurately.

IV. Accidents which can be prevented by physical barriers are almost always the easiest type to prevent.

These four assumptions place physical barriers in a proper perspective. While stressing their importance, their limitations are also defined.

In order to do a Physical Barrier Analysis, we need:

1. accident information,

2. groups of physical barrier analysis statements,

3. a physical barrier analysis matrix,

4. instructions.

ACCIDENT INFORMATION

Although any accident report can be used, the accidents we will analyze are the degree 1-6 ones from the MSHA printout, Metal/Nonmetal Accident and Injury Abstract. Since this information comes from the 7000-1, that document could also be used.

From the form we will be primarily using the narrative description of the accident. The narrative is on the right side of the printout. The only purpose for using the information on the left side of the narrative is if it will help us to understand the narrative.

The first thing we will do in analyzing the accident is to read the narrative and visualize what happened. Often the report is sketchy but most of the time we will be able to draw on our experience to read between the lines and get the picture.

EXAMPLE: In the 2 south one left section a timberman while setting a post struck a wedge with his ax. The wedge splintered and cut his right eyeball.

Once we have visualized the situation and what occurred, we then ask, "What could have prevented this accident?" To help us determine the appropriate preventive measures, we have provided a list of Physical Barrier Analysis Statements.

The statements refer to each of the four types of physical barriers. For each type there are four possibilities. Going back to our example of the wedge and using our PBA statements we want to find the one statement, for each type of physical barrier, which best fits our opinion.

PHYSICAL BARRIER ANALYSIS STATEMENTS

For each of the four (4) types of barriers described below select the statement which best represents your opinion of the accident.

1. A physical barrier on the energy source was:
   (Prevent Release)

   a) not possible and practical
   b) practical and possible, but not provided
   c) provided, but not used
   d) used, but failed

2. A physical barrier between the energy source and the person was:
   (Prevent Contact)

   a) not possible and practical
   b) practical and possible, but not provided
   c) provided, but not used
   d) used, but failed

3. A physical barrier on the person was:
   (Prevent Forcefulness)

   a) not possible and practical
   b) practical and possible, but not provided
   c) provided, but not used
   d) used, but failed

4. A barrier of time or space between the energy source and the person was:
   (Prevent Contact)

   a) not possible and practical
   b) practical and possible, but not provided
   c) provided, but not used
   d) used, but failed

If we think that a physical barrier on the energy source was not possible and practical, we would select 1a. Once the (a) has been selected it is not necessary to check b, c, and d. We would simply go to Statement 2.

If, in looking at Statement 2, we decide a physical barrier between the energy source and the person was not possible and practical, we again choose (a) and proceed to statement 3.

In Statement 3, the not possible and practical is probably not our opinion since safety glasses probably would have prevented the accident. Therefore we must go through the remaining statements b, c, and d to determine our selection.

Since we believe a physical barrier on the person was possible and practical, we must decide if it was not provided, provided but not used by the person, or used but didn't protect the person. Making that choice depends on our experience and knowledge of the mine.

Therefore if our knowledge and experience leads us to believe that the mine normally doesn't provide safety glasses, we would select (b) and go to Statement 4.

If we believe the mining operation routinely provides safety glasses, but workers usually don't use them, you would select (c) and proceed to Statement 4.

If we believe that the mine operation is a stickler for safety glasses, then we might suspect glasses were worn, but failed, and we would select (d) and then proceed to Statement 4.

If in looking at Statement 4 we believe that a time or space barrier was not possible or practical, we would again select (a).

We have now made our choices, 1 was (a), 2 was (a), 3 for purpose of the example was (c), and 4 was (a). We now want to record our answers on the PBA matrix.

The PBA matrix is simply our PBA statements in a different format. Normally we will be analyzing many accidents. When we do, we number our accidents so we can record our choices for each accident. Each accident has four choices. If our example was accident #1, we would place a one in the appropriate cells corresponding to our selections. In our example a 1 would be placed in cells 1A, 2A, 3C, and 4A.

We have now completed the Physical Barrier Analysis of one accident. We have listed the process we normally go through in the PBA instruction.

PHYSICAL BARRIER ANALYSIS MATRIX

	1	2	3	4
	Barrier on the Energy Source	Barrier between Energy Source and the Person	Barrier on the Person	Time/Space Barrier Separating the Energy & the Person
A Was Not Possible and Practical				
B Was Possible and Practical but Not Provided				
C Was Provided but not used				
D Was Provided and Used but Failed				

PHYSICAL BARRIER ANALYSIS INSTRUCTIONS

1. Gather the accidents you wish to analyze.

2. Number them sequentially.

3. Starting with number 1, read the abstract and visualize the accident.

4. Ask yourself the first group of four questions on the PBA question list. Choose one of the four which best represents your opinion.

5. Ask yourself each of the remaining four groups of questions. Make one selection from each group.

6. Transfer your selections to the PBA matrix.

Now that we have gone through an example, certain questions are in order.

Question - Why go through all four types of Physical Barriers? When I've decided the barrier that was missing I should be able to record in one cell right in the matrix.

Answer - Once you begin to use the Physical Barrier Analysis, the statements, matrix and instructions, you should be able to short cut the process we've described. You'll probably not even have to use the organizers we've presented.

But a word of caution. Once you begin to think in terms of the four types of Physical Barriers and the purpose each serves, you may begin to realize that there are more possible and practical physical barriers than you have considered.

Question - When there is so little data in the narrative, how can I be expected to analyze what happened?

Answer - Our position is that we are aware of your expertise. You know the mines in your area, the environmental conditions and the operating procedures. There is probably not an accident that could occur that you haven't seen before and have a good idea what probably happened.

Question - What if I have a small mine that doesn't have many accidents? Why do I have to go through all this work?

Answer - With few accidents you probably don't. You can analyze those accidents in greater depth. But the PBA is more than just a matrix with numbers on it. It is a way of thinking about accidents; a different perspective.

The bottom line of the physical barrier analysis is that when we've finished analyzing the accidents, we will find clusters of accidents in the matrix. We will no longer be looking at haulage or fall of ground or electrical accidents. What we will be looking at, for example, could be "accidents that could have been prevented by a barrier on the energy source".

One of the primary benefits of the PBA is to help us formulate areas of interest or concern for which we will seek additional information when we are at the mine. In this case, that concern might be why those barriers weren't provided. When we find that out, we will know how to prevent accidents in that category.

EXAMPLE 2: In 2 right off 9 face an electrician was preparing to splice shuttle car cable. While cutting insulation, he received burns to both hands and electrical shock.

Using the PBA instructions and statements, in what cells in the PBA matrix would you place this accident. Remember you will have a response in each of the columns 1, 2, 3, and 4.

We would suspect that a lock and tag would be provided but probably wasn't used. Lock out and tag would be a barrier on the energy source. There are likely no other barriers possible that would have prevented this accident. We would put this accident in 1C, 2A, 3A, and 4A on our PBA matrix.

Physical barriers are an excellent way to prevent accidents. They remove human judgment from the situation. The regulations that MSHA enforces are primarily mandated physical barriers. The absence of the physical barrier increases the likelihood of an accident. Mines which are neglecting the use of practical, economical physical barriers are denying themselves the benefits of the most efficient prevention methods known to the industry.

Human Barrier Analysis (HBA)

When we discussed physical barriers, we indicated that the absence of a physical barrier increased the likelihood of an accident. Therefore, if we put the appropriate physical barriers in place, we should reduce or prevent those kinds of accidents.

Human Barriers work the opposite. It is the presence of human barriers which increases the likelihood of accidents. The presence of human barriers prevents an individual from making the appropriate response.

A. Human barriers increase the likelihood of an individual doing something that shouldn't be done--for example, going under unsupported back.

B. Human barriers decrease the likelihood of an individual doing something that should be done--for example, locking out and tagging disconnecting devices before working on electrical equipment.

When we use physical barriers, we are changing the physical environment in which the person works. We recall from the swimming pool analogy that we had some solutions that didn't involve changing the physical enviroment. Those solutions involved doing something to the child (teaching or punishing). When we deal with human barriers, we try to change factors which directly impact the person, or try to change the way the person responds.

In doing the Human Barrier Analysis (HBA) there are three assumptions we make.

I. There are logical, understandable reasons why people perform in ways which lead to an accident.

II. Those reasons usually take the form of barriers which:

a. Reduce the likelihood that people will perform in ways which prevent accidents.

OR

b. Increase the likelihood that people will perform in ways which cause accidents.

III. Identifying and eliminating those barriers will increase the likelihood of performance which reduces accidents and reduces the likelihood of performance which causes accidents.

These assumptions are fairly straightforward. There may be some question about the first one. Often we regard the performance of others as illogical, incomprehensible, and sometimes downright stupid. When we begin to look at their performance from a point of view other than our own and look at it in more depth, we find logical and understandable reasons. The human barrier analysis helps us discover these reasons.

There are five major barriers to human performance. Individuals do not perform appropriately because of a deficiency in or lack of:

A. Information
B. Proper tools
C. Knowledge
D. Capacity
E. Incentives

In doing a Human Barrier Analysis we look at accidents which could have been prevented by the individual involved. We wish to know if the presence of one of these barriers caused the accident. As in Physical Barrier Analysis, our experience in mining, our knowledge of the mines in the area and the operating procedures provide a basis for answering the HBA questions.

A. Information:

When people are not informed of what is expected of them, when they are not told how well they are performing, or when they are not given any guidance or clear direction on how to accomplish a task, an information barrier is present. The lack of consistent, practical operating procedures or the lack of feedback creates situations where people respond based on their own judgments of how things should be done. Often the behavior is incompatible with other aspects of the operation.

To determine if there was an information barrier, we ask the question: WAS THE PERSON GIVEN DIRECTION AND GUIDANCE ON HOW TO DO THE JOB? We use direction and guidance as our key words in the question since they cover both expected performance and feedback for performance.

Example of an information barrier:
The roof bolter is not told that the roof control plan requires the torque testing of the first bolt and one out of every fourth bolt installed. We should not be surprised if the task is done incorrectly. The absence of information created a barrier to human performance.

Guidance and direction can come from a variety of sources. Written plans, policies, and procedures can be direct and guide behavior as well as verbal direction and guidance from supervisors and co-workers. Whatever the sources, however, direction and guidance that is not clear, consistent, or accurate can be an even greater barrier to human performance than no information at all.

B. Tools or Equipment:

When the appropriate tools or equipment to do a job are not available or are improperly designed, a barrier to human performance is created. Where improper design is the cause for problems, we are generally talking about human factors. Tools are not physical barriers since they generally do not function to protect the person in some way from the energy source. Tools and equipment are extensions of the person which are instrumental in getting the required performance.

To determine if tools or equipment are a barrier, we ask: WERE THE APPROPRIATE TOOLS OR EQUIPMENT AVAILABLE AND WERE THEY PROPERLY DESIGNED FOR THE JOB?

Example of tools as a barrier:
A roof bolt was used to take down loose top because the correct bar was not provided.

C. Knowledge:

Sometimes people do unsafe things because they don't know any better. When they don't know how to perform safely, we have a barrier (knowledge) to human performance. Knowing how to do things safely is acquired principally through education, training and experience. Deficient, limited or non-existent education, training or experience may be our clues to the fact that we have a knowledge barrier.

The question we ask to see if there is a knowledge barrier is, "DID THE PERSON KNOW HOW TO DO THE JOB AS IT IS SUPPOSED TO BE DONE?"

Example of a knowledge barrier:
The roof bolter is told to torque test the first and one out of every four bolts he installs. If he doesn't do it properly because he doesn't "know how" to use the torque wrench, we have a knowledge barrier to human performance.

Knowledge is not the same as information. It implies much more. It implies that the person can use information, can put his/her education, training, and experience together so that s/he can appropriately act on information. Knowledge is, therefore, internal to the person, something that the person brings into the work environment. Externals such as information and incentive operate on the person's use of knowledge.

D. Capacity:

Capacity is also internal to the person. Capacity is both mental and physical. When a task exceeds the capacity of the individual performing or when something impairs the person's capacity, a barrier to performance exists. The impairment of capacity can take many forms.

If the job requires an extended high level of concentration, a person with a short attention span will be at a disadvantage. The task exceeds the person's capacity. A job may also become so routine that it is done by habit. This habit may be so strong that changes in the environment, which require a different response, are not recognized. In this case, habit has impaired the mental capacity of the individual to attend to the environment. More obvious examples are the person who is asked to lift more than s/he could possibly handle, or the person who comes to work under the influence of drugs.

These impairments of physical and mental capacities have the potential of turning hazardous situations into disaster for the individual and others. To determine if there is a capacity barrier we ask, "DID THE TASK EXCEED THE CAPACITY OF THE INDIVIDUAL PERFORMING IT?"

E. Incentive:

One of the most powerful means of strengthening, maintaining and changing a person's responses is the use of incentives. Our responses result in rewards, and punishment which can create barriers to human performance. When unsafe performance has been rewarded or safe performance punished, we can expect the inapproriate performance in the future. If cutting corners on safety in order to increase short term production is rewarded, the frequency of cutting corners is going to increase.

To determine if incentives have created a barrier to human performance we ask "HAS THE PERSON BEEN REWARDED FOR DOING THE JOB INCORRECTLY OR PUNISHED FOR DOING IT CORRECTLY?"

Example of an incentive barrier:

The roof bolter is told to torque test the first bolt and one out of every four bolts he installs. He knows how to do it but in not doing so he can get bolted up before the miner finishes the next cut. When he is waiting on the miner, he can take a break. The foreman knows what's going on but declines to intervene. The man is rewarded for unsafe performance resulting in an incentive barrier to proper performance.

In this example the roof bolter is reinforced by the break, because his finishing the job fast leads to the break. Note also a second thing. The foreman ignores the unsafe behavior, and therefore, doesn't provide direction and guidance. There are times when there may be a fine line between determining whether the barrier is misuse of incentive or lack of direction or guidance. However, our knowledge of the operation of the mines should help us in making that determination.

There is a tendency, when discussing incentives in the mining industry, to think in terms of the mine's incentive program. While the incentive program is important, it is a small part of the concept we are presenting. Our major concern is those little things that occur or fail to occur after the person has responded. While the opportunity for bonuses, promotions, jackets and the like are important, it is usually events like praise from one's supervisor or cohorts, or a ribbing from one's work crew that are powerful determinants of behavior. It is these events which occur in the normal, everday interactions at the work site that need to be considered if an incentive barrier exists.

Example:

An individual wears safety glasses while the rest of the work crew doesn't. The crew may poke fun at the person until he stops wearing the glasses. Being a part of a group and getting support from the group are powerful incentives in determining performance.

When analyzing accidents for human barriers, we need to realize that the five barriers we have discussed often operate together. It is an advantage to present them independently for understanding. However, it is also important to make five judgments as to which barrier may be the primary contributor to an accident. Each type of barrier not only requires a different type of solution, but the implementation costs of the solutions are quite different.

BARRIERS TO HUMAN PERFORMANCE

INFORMATION (DIRECTION AND GUIDANCE) (See P. 27)

Was the person given direction and guidance in regard to performing the job?

TOOLS AND EQUIPMENT (APPROPRIATE TOOLS OR EQUIPMENT) (See P. 28)

Were the appropriate tools or equipment available and properly designed?

KNOWLEDGE (KNOW HOW) (See Pp. 28-29)

Did the person know how to do the job as it was supposed to be done?

CAPACITY (PHYSICAL CONDITION/IMPAIRMENT) (See P. 29)

Did the task exceed the capacity of the individual performing it?

INCENTIVE (REWARD OR PUNISHMENT) (See Pp. 30-31)

Has the person been rewarded for doing the job incorrectly or punished for doing it right?

DOING THE HUMAN BARRIER ANALYSIS

The Human Barrier Analysis (HBA) proceeds from the data we have on the Physical Barrier Analysis matrix. We will be concerned with the data in the rows:

A. Was not possible and practical
B. Was possible and practical, but not provided
C. Was provided but not used
D. Was provided and used, but failed

The matrix categorized the accidents into two groups. In one group, a barrier would have prevented the accident (Rows B & D). In the second group (Rows A & C), human behavior played a significant role.

A & C accidents are accidents where a contributing factor was individuals who did something they shouldn't have or didn't do something they should have. All mines have accidents of this type. The human barrier analysis is our tool for further analysis of the accidents in A & C, where human behavior played a role.

The first task is to determine which accidents in A & C require analysis. To help us organize, we use the HBA Tally sheet shown on the next page.

To determine which accidents are to be analyzed in Row A, we simply check to see which accident numbers appear in all four columns of the row. The numbers of those that do are listed in the column under accident number on our HBA Tally Sheet. They are accidents we want to analyze further.

Group A or C (circle one)

HBA TALLY SHEET

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentives

Group A or C (circle one)

HBA TALLY SHEET

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentives

Example:

Accident 1 occurs in cells A1, A2, A4
Accident 2 occurs in cells A2, A4
Accident 3 occurs in cells A1, A2, A3, A4
Accident 4 occurs in cells A1, A2, A3, A4
Accident 5 occurs in cells A1, A3, A4

Of the above accidents, only Accidents 3 and 4 will be placed on the HBA Tally Sheet. In these accidents none of the four types of barriers were possible or practical.

We use a second HBA Tally Sheet for recording group C accidents to be analyzed. We will analyze all accidents which occur in row C. It does not make any difference which barrier was not used. If an accident occurs in more than one cell, we only need to put it on our HBA Tally Sheet once.

Example:

Accident 1 occurs in cell C1
Accident 2 occurs in cells C2, C3
Accident 5 occurs in cell C4
Accident 9 occurs in cells C2, C3, C4
Accident 13 occurs in cell C3

Each of these accidents are put on the HBA Tally Sheet once.

After we have recorded the accidents from rows A & C on the Tally Sheets, we are ready to do a HBA. We now go back to the accident abstract and for each accident we will ask the questions to determine which human barrier was operating. (Questions are shown on the next page.)

When analyzing each accident, we put ourselves in a forced choice situation. We may only select one of the five possible human barriers as the cause of the accident. Using our experience in the mining industry, our knowledge of the mine operations, and procedures, we decide which of the human barriers we think probably led to the performance which contributed to the accident. Then we place a check mark in the column under the appropriate barrier for that accident. For each accident we have on our Tally Sheet, we should end up with one check mark in one of the five columns.

PRELIMINARY DATA ANALYSIS: WRAP-UP

We have now been through the elements of the PDA. By now we should realize that this system is not doing our thinking for us, but instead, provides us with the tools to help us do our thinking in a clear, consistent manner. Its design intends to steady our course and at the same time encourages flexibility in pursuing areas of potential use. The supervisory role of organizer and director of the project should also be coming into focus. Consistent, progressive, efficient programs do not run themselves. A tempered rein is normally required to insure such things.

There are some additional areas that we need to think about which will give us a chance to solidify our roles and responsibilities to make the system work.

Our purpose in the PDA was to familiarize ourselves with the accidents in an effort to establish some broad perspective of what may be causing them. PBA and HBA are only fast screen. As in all fast screening mechanisms, we are willing to trade off a degree of accuracy for expediency. If we are 10% off in our placement of accidents into groups, this is certainly understandable and acceptable considering the lack of information on many of the accidents. Since we look at major groupings or clusters, it really won't make or break us if we miss an accident that probably should have gone in Group A instead of Group C. The result may have made Group A contain 75 accidents instead of 76. So what?

If we are inclined to lean one way or the other, we should give the benefit of the doubt to all groups except Group A. Since Group A will normally be the largest, it's easy to begin to throw everything into Group A without just consideration of the other categories.

We take what's given about the accident, read into it what we have to to make sense out of it, trust our instincts and when we're finished, our margin of error will be well within the acceptable limits. Mainly we must be consistent. Lack of consistency really shows up when we put Accident #1 in Group A and Accident #73 in Group D when they are identical. Lack of consistency can jeopardize any potential usefulness of the PBA and HBA.

There is no clear cut number of accidents one should set out to analyze. Generally, 100 accidents is broad enough coverage to exhibit the breakdown of accidents into their representative groups.

If we begin with 10 accidents, for example, it's difficult to get any meaning from the fact that three accidents are in Group 2, two in another, etc. There just isn't enough difference between 3 and 2 to make viable assumptions based on that difference.

If we have a mine with few accidents, say 10 to 20 that we were interested in, we would probably handle the analysis a little differently. Because the number of accidents is small, we can go to the mine, get additional information about each accident, and then factor them into their respective groups as per the PBA and HBA.

But it is important to remember that the HBA and PBA are more than a set of tools. They are a different perspective, a different way of looking at accidents. Even if the mine only had one accident, we would still want to look at it in terms of PBA and HBA, even though we would not go through paper work of PBA and HBA.

There is no hard and fast rule on how far back to go. Do we look at accidents dating back one year, two years, three years? If we were dealing with a large mine which is above the national average, we may not have to go past one or two months to get our 100 accidents.

Has there been a sudden increase in accidents? If so, in order to find out which group accounts for that increase, we will have to analyze accidents before the increase to find out what types were happening before, analyze those that are happening after the increase, and compare the two results to see how they differ.

When we say we can't tell you how many and for what time period to analyze, we are in essence saying that we do as many accidents as resources permit over the time period that we think will yield the most useful insight.

We are putting a puzzle together. Before we can put the pieces together to make something out of them, we must first find them. The PDA yields the first piece.

Before any program of this nature is taken to a mine, something or someone must initiate it. We do not have nor do we wish to have any control over what mines need the program. We can, however, discuss some of the ways mines may be selected for the program.

1. MSHA may decide arbitrarily.
2. MSHA may devise mathmetical selection process.
3. An operator may request it.
4. The program or parts of it may be used in the course of normal inspection work at all mines.

Irrespective of the selection procedure, let's assume that we are assigned a particular mine (target mine) on which to concentrate efforts in reducing accidents. Let's also assume that we want to try this system. Where do we start?

1. Select personnel who will comprise the project team.
   A. Two, possibly three team members work best.
   B. Personnel who have received training in the system.
2. Hold a team meeting outlining the job to be done.
   A. Identify mine
   B. Assign duties
   C. Develop schedules
      (1) PDA
      (2) Initial contact
      (3) On site
      (4) Data integration
      (5) Presentation of findings
   D. Select team leader
   E. State facts that are known about the case
3. Clarify to the team what the leader's role will be
4. Clarify what is expected from the team members
   A. Progress checks, etc.
   B. Reports, etc.

We have used the accident narratives as our primary source of data in the PBA and HBA. This doesn't mean that we are limited to using those data in the PDA. We may have other data we think will be useful: fatal reports, other accident reports, information from inspectors who have inspected the mine, etc. If we think it will be useful, we should use it.

Sometimes people learning the PBA and HBA become overwhelmed at the time it takes to learn the techniques. From that they assume a lot of time and human resources will be required. When someone has learned to use the HBA and PBA and is comfortable with it, it is very easy for one person to analyze 100 accidents in a couple of hours.

INTERPRETATION OF PBA - HBA

We wish to use the PBA and HBA data to direct us in carrying out a systematic and directed investigation at the mine site. Since our resources are limited, the fast screen provided by the PBA and HBA, will allow us to direct our resources better at the mine. The PBA and HBA will lead us to the kinds of things we want to look at and the kinds of questions we want to ask when we get to the mine.

In analyzing the PBA and HBA data, we first look for clusters of accidents. Using the PBA matrix on the next page, let's see what we can find. Of the 50 accidents:

1. 21 - Barrier not possible or practical
2. 9 - Barrier not provided
3. 18 - Barrier not used
4. 2 - Barrier failed

   50

We also have clusters of accidents where:

5. A barrier between the energy source and person was not used, (7)
6. A barrier on the person was not used (12)
7. A barrier on the energy source wasn't provided (5)

The absence of accident clusters also gives us some information. Only two barriers failed. This could mean we probably have a pretty well engineered operation. Since items 1 and 6 above required the HBA, we will use those data to determine our potential causes.

Looking at just Row B, we then can say we have a group of accidents resulting from barriers not being provided. We probably don't want to look at the cells in Row B separately since the clustering in individual cells isn't that large.

PHYSICAL BARRIER ANALYSIS MATRIX

	1 Barrier on the Energy Source	2 Barrier between Energy Source and the Person	3 Barrier on the Person	4 Time/Space Barrier Separating the Energy & the Person
A Was Not Possible and Practical	1,2,4,6,7,8,9,10,11,12,13,14,15,16,17,18,20,21,22,23,25,26,27,28,29,30,31,32,33,34,36,37,38,39,40,41,42,43,44,46,47,48,49,50	1,2,3,4,5,6,8,9,10,14,15,16,17,18,19,20,21,22,23,24,26,27,28,29,30,33,34,35,37,38,40,41,42,43,44,45,46,48,49	1,3,4,5,6,7,8,9,10,12,13,14,15,17,18,19,21,22,24,25,26,27,28,30,31,32,34,35,37,38,40,41,42,43,44,45,48,50	1,2,3,4,5,6,7,9,10,11,12,13,14,15,16,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,41,42,43,44,45,46,47,48,49,50
B Was Possible and Practical but Not Provided	3,19,24,35,45	13,31,50		17
C Was Provided but not used		7,11,12,25,36,39,47	2,~~11~~,16,20,23,29,33,~~36~~,~~39~~,46,47,49	8,40
D Was Provided and Used but Failed	5	32		

The question is now: from our knowledge of mining and the operation we are reviewing, why wouldn't these barriers be provided, when in fact they are possible and practical? Maybe no one at the operation realized the barriers were possible; maybe the miners kept telling the supervisors that the barriers were missing, but the supervisors didn't do anything about it; maybe no one was aware the barriers were missing; or maybe the maintenance staff was repairing the barriers and didn't provide a replacement. There could be a host of possible causes, only some of which are likely at the operation we are looking at.

From our knowledge, we can make a statement of potential cause:

> "There appears to be a good proportion of accidents that result from physical barriers not being provided. It is very likely at this operation, supervisors are not providing those barriers or taking action to insure the barriers are provided."

We must remember that the purpose of this statement is guidance in our planning of on-site activities. If we suspect a supervisory problem, we can concentrate on that rather than using our resources elsewhere. We will come back and develop this potential cause later.

The PBA clustered accidents in Rows A and C. Thus, we see that we have two large groups of accidents that were the result of "people problems." We now go to our HBA to find out what may be the potential causes (next two pages). We have two clusters of accidents. One where information (lack of guidance or direction) seems to be the cause. The other cluster is in the incentive category.

Using our experience in mining and our knowledge of the particular mine operation and procedures, we ask what could be going on? Maybe management's support of safety isn't getting down to the supervisors. Maybe the supervisors know management's safety posture, but are being rewarded for cutting corners to increase production. Could it be that safety procedures simply aren't clear? Or maybe the worker is being reinforced for cutting corners, possibly punished when s/he does the safe thing?

Group (A) or C (circle one)

HBA TALLY SHEET

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentives
1	✓				
4				✓	
6				✓	
9	✓				
10	✓				
14	✓				
18			✓		
21			✓		
22				✓	
26	✓				
27	✓				
28	✓				
30					✓
34					✓
37				✓	
38			✓		
41	✓				
42	✓				
43	✓				
44					✓
48	✓				
TOTALS	11	0	3	4	3

Group A or C (circle one)

HBA TALLY SHEET

Accident Number	Information	Tools and Equipment	Knowledge	Capacity	Incentives
2					✓
7					✓
8					✓
11			✓		
12					✓
16	✓				
20	✓				
23	✓				
25					✓
29					✓
33					✓
36					✓
39					✓
40					✓
46	✓				
47					✓
49			✓		
50					✓

We then have two more potential causes to look into.

> It appears that the reward system at this operation is resulting in people being rewarded for cutting corners and behaving unsafely.
>
> It appears that management's concern for safety is not being adequately communicated through the foremen to the workers.

While we don't know exactly why the incentive or communications systems are inadequate, we do suspect they are potential causes for many accidents. Again, this offers guidance in our planning. It is unlikely we would look at miner training if we suspect an inadequate reward system.

We also had a few accidents in our HBA which indicated a knowledge and capacity barrier. We have not used those accidents to determine potential causes, because we want to use our limited resources the best way possible. Our HBA indicates we will get the most mileage out of looking at information and incentives.

We can now better define what we want to look at when we go to the mine. The planned inquiry sheet on the next page will help us organize for on-site activities. The inquiry sheet has been filled in to provide an example of what it may look like when used to plan for on-site activities. The information comes again from our experience and knowledge. The information is abbreviated and directs us only to key areas. Our example has a limited number of questions. In practice we would have several questions for each area we want to look into (next page).

PLANNED INQUIRY SHEET

POTENTIAL CAUSE	AREAS TO LOOK INTO	SPECIFIC ASPECTS OF THESE AREAS FOR WHICH WE HAVE QUESTIONS
Barriers not being provided by supervisors.	Odering supplies, Supply budget, Detection plan, coordination between workers, supervisors, and Supply Supervisory knowledge of barriers, Supervisor's authority	• How the supervisor fits into the identification, requisitioning, supply chain? • State of supervisory knowledge of barriers, their form and purpose? • Who has responsibility for detecting lack of barriers and is the responsibility formalized?
Information not being clearly passed from supervisors to miners.	Availability of information Communication chain, Worker's perceptions, Observation of communication process, Clarity of information	• Do the workers think they are getting the straight poop from supervisors? • Is the communication problem widespread or specific to a topic, crew, or management group? • How do employees find out what management expects of them? • What kind of feedback system exists?
The incentive system is rewarding people for unsafe behavior.	Workers' perceptions, Management's modeling behavior, Observation of consequences of work procedures, Supervisor's knowledge of the use of incentives, Work group control	• What kinds of incentives are given at the work site? • Are safe behaviors being punished? • Do workers view the incentives as unfair? • Is the lack of incentives widespread or specific to certain supervisors? • How does management use incentives with supervisors?

In our questions we have asked nothing about miner training, but did ask about supervisory training. We have asked about some inspection procedures, but not maintenance. This was the purpose of the PBA and HBA analysis: to narrow down those areas at the mine that we want to look at that will lead to the most information at the lowest resource cost.

PLANNED INQUIRY SHEET

POTENTIAL CAUSE	AREAS TO LOOK INTO	SPECIFIC ASPECTS OF THESE AREAS FOR WHICH WE HAVE QUESTIONS

ON-SITE

Regardless of the quality of the product from the Preliminary Data Analysis, the project cannot achieve anything unless we are successful in gaining additional information on-site. On-site data will change probable causes to actual causes. It will change "we think" to "we know"; it can change "I'll be darned if I know what to suggest" to "you may want to consider trying this". In short, any potential this approach has for reducing accidents rests with our ability to obtain information which helps us understand how they can be reduced.

All of the information we collect will not serve us in reducing accidents. It's easy to see how a great deal of time and resources could be expended at a mine for the collection of volumes of data only to discover in hindsight that what we've collected doesn't help much in understanding what's going on. Most of the time anything we get can be of some help but truly premium information is that which helps us understand what problems exist, why they exist and how they are causing accidents.

If we have made the PDA work for us, we have (based on the accidents) an educated guess as to what underlying factors may be the primary difficulty at this mine. If our speculation was correct, the answers to the type of questions we developed on the planned inquiry sheet are in essence, premium information.

Two traditional approaches to obtaining the kinds of data we need are the interview and direct observation. Both have been practiced for years by MSHA personnel. As applied to this accident prevention system, each approach has two modes between which we may find ourselves alternating as the situation dictates.

These modes - planned and impromptu are so named because the names describe the mode.

Planned observations and interviews are a direct result of the planned inquiry product. At the mine site we follow up on the notes we have made to ourselves on the planned inquiry sheet. Now is our chance to ask the questions we jotted down at the office as we said to ourselves, "If I only knew this, I could make some sense out of things." Now is our chance to look at items we listed on the planned inquiry sheet. After analyzing a group of accidents, we said to ourselves, "I'll bet they do that all of the time." Now is our opportunity to get answers to all of the questions which should have been raised as we studied the accidents.

While the planned observations and interviews should yield the greatest amount of premium information, we should be careful not to discount the importance of "playing it by ear." The impromptu mode encourages us to pursue avenues which we hadn't previously considered, or ask questions which our preliminary information didn't bring to mind.

The ability to function in the impromptu mode brings out the dynamic nature of this approach to its fullest. It swings into action when someone tells us something that seems worth pursuing even though we hadn't planned to ask about it; or it is being practiced, when in the course of observing a unit in operation, we spot something which, with our recall of the mine's accidents, produces useful information.

Planned work gives the inquiry a sense of direction and focus. Impromptu work allows the flexibility to explore based on immediate need.

They are the tools of the skilled analyst. All of the answers are out there. When the on-site work is completed, the sharp interviewer knows if he hasn't gotten them, he hasn't asked the right questions.

In many cases sources of information, in addition to interviews and observations, are useful. Items such as company records, policy memos, plans, programs or any other material which indicates how the operation conducts business may in the end help tie things together.

ON-SITE: OTHER CONCERNS

By its very nature, an AP approach such as this operates on an "ask for" basis as opposed to a "demand" basis. The kinds of information we're going to attempt to acquire will only come our way when a non-adversarial climate is established at the outset and nurtured at each juncture of the project. In view of what in many cases are tenuous relationships going in, any precautions we can take against slip-ups which jeopardize our effectiveness, are certainly advisable. As we all know, many operations which are most in need of assistance are the least amenable to such an offering. It is a fact, however, that when a sensible, practical, equitable plan is laid out with no hidden agendas, operations people sometimes listen.

As we meet with operations and labor representatives we should lay all of the cards on the table, so to speak. Discuss with them what is about to take place, how the project is designed to work, what role they will play, and above all, what they can expect to get from it.

Examples of the types of things we may wish to bring up for discussion are:

> The objective of the project is to reduce accidents by identifying aspects of the operation which are contributing to them so that they may be modified or eliminated.
>
> Those aspects are systematically identified by collection and analysis of accident data, observation data, and interview data.

The team members, even though they are inspectors will not be operating in the traditional inspection role. The project differs from a regular inspection in that:

INSPECTION	AP
1. Unannounced	1. Mutually convenient times
2. Observation of conditions to determine compliance with mandatory standards.	2. Collection of accident, observation, and interview data to determine underlying factors which are causing accidents
3. Miner's representative and/or company representative usually accompany inspector	3. Only need a guide
4. Usually one inspector	4. Usually a team
5. Perceived as: "Hide things because when he finds them, it will cost us."	5. Perceived as (hopefully) "Share your opinions with him and maybe he can help us. After all it doesn't cost anything."

Ask that employees be made accessible. The team will conduct interviews with a sample of miners and supervisors. They will basically be asking for opinions as to what problems are causing accidents.

Interviews will be conducted at the employees' work site on a confidential basis with only the person being interviewed and the team present. No information regarding the sources of information will be revealed. Intimidation by supervisors standing near interview is undesirable.

We are aware of the value of employees' time. If they weren't needed, they wouldn't have been hired.

We will not interview employees who are doing a job that requires constant attention while they're occupied. We will try to disrupt normal operations as little as possible. We will try to interview and observe on all shifts and all sections. We will explain to each person interviewed who we are, why we are here, and what we are trying to do. We will consider ourselves guests, trying to schedule activities convenient to the operation. We need the support of both management and labor. Lack of cooperation can produce invalid results.

We are not interested in managing the mine, only holding up a mirror to those who do so that they get a clearer picture of those aspects of the operation which are causing accidents. The result of the project will be suggestions, made in good faith that they represent positive actions that the company and its employees may take to reduce accidents.

Discussion of these types of items should demonstrate to the operator that our plan is well thought out, that we do intend to be considerate of his/her needs and above all that we are sincere in our desire to help him/her reduce accidents.

ORGANIZATION OF INFORMATION

I. Introduction

As indicated in the overview, the purpose of this step is to put all the data together to form a logical sequence which will support our recommendations. Our bottom line is to know -

What is causing problems at the mine

What are the problems

What accidents resulted from those problems

What action can be taken to eliminate or alleviate those causes and therefore reduce the problems and accidents

By the time we get to this step we should have gathered all the data that we need to answer those questions. However, we probably have a lot of data, some specific, some general and some related to several causes or problems. Some of the data we may want to use as gathered and some we may wish to summarize. Whatever the case may be, we want to present the strongest case possible.

II. The "MAD" Method

For those unfamiliar with Mad Magazine, every now and then it has a section where readers can create their own stories. The readers are given a story line with parts missing and they choose from columns of words to fill in the missing parts. Example:

When the ___(A)___ falls ___(B)___ will ___(C)___ in the ___(D)___.

Fill in the blanks by choosing a word(s) from the appropriate column.

A	B	C	D
atom bomb	Lassie	turn green	river
rain	my boss	lose his hair	White House
moon	Jim Beha	get fat	management ranks
stock market	Andy Capp	go to sleep	trunk of a VW
pizza	General Motors	cut back	barn

As you can see, what is filled in the blanks can be as logical or illogical as one wishes to make it. The choice of one inappropriate word can turn the otherwise meaningful statement into sheer nonsense.

Since we have such a mass of data from our data collection and analysis, we propose working from the "Mad Model" to put together our findings and recommendations. Instead of filling in the blanks we will put the information together in "columns" to make our case.

We have five columns:

1	2	3	4	5
Interviews & Observational Data Supporting the Problems	Problems	Accidents Resulting from the Problems	Causes	Recommendations
This is the information that was gathered at the mine site. The raw data and/or summaries of the data can be used. This data could be pertinent to one or more problems.	The problems result from the interviews and observations done at the mine site. These are statements of a problem which are supported by the data in Column 1. The problem is a statement which cleans up or summarizes the data from the field.	The accidents come from the data base used to carry out the PBA and HBA. Now we want to know which of those accidents resulted from the problems identified in Column 2.	The basic causes are determined from the problems identified in Column 2. Several problems could result from the same cause or a problem may have more than one cause.	The recommendations follow from the causes since it is the causes we are trying to eliminate. Many of our recommendations will come from our experience of what has worked before in other situations. However, there are some basic guidelines for dealing with problems resulting from the presence of human barriers.

Where do we begin? Whoever collected the field data probably has a good idea what the problems are at that mine. Since Column 1 is a detailed account of Column 2, they can be done interchangeably. The goal of the initial step is to create a problem list which is derived from and supported by the field data. For example:

Problem	Mine Site Data
Supply Procedures appear to be ineffective.	Miners have stated that they have worked with equipment in need of repair because replacement parts were unavailable.
	Maintenance personnel indicated that replacement parts are often not available.
	There were times when the wrong part was provided to repair a piece of equipment.
	Foremen stated that there was no established procedure for ordering supplies.
	Supply personnel said that established procedures were not used. One individual stated: "There is no thinking ahead on what could go wrong. Everyone expects everything now."

For each problem, there will be supporting data. Some problems may have much support, others little support. Note also from our example that some of the data could be used to support another problem. The item - procurement personnel said established procedures were not used - would support a problem concerning information not being made available. For all practical purposes, the problem statement and the supporting data are not separable. The problem statement is a summary or a conclusion of the supporting data.

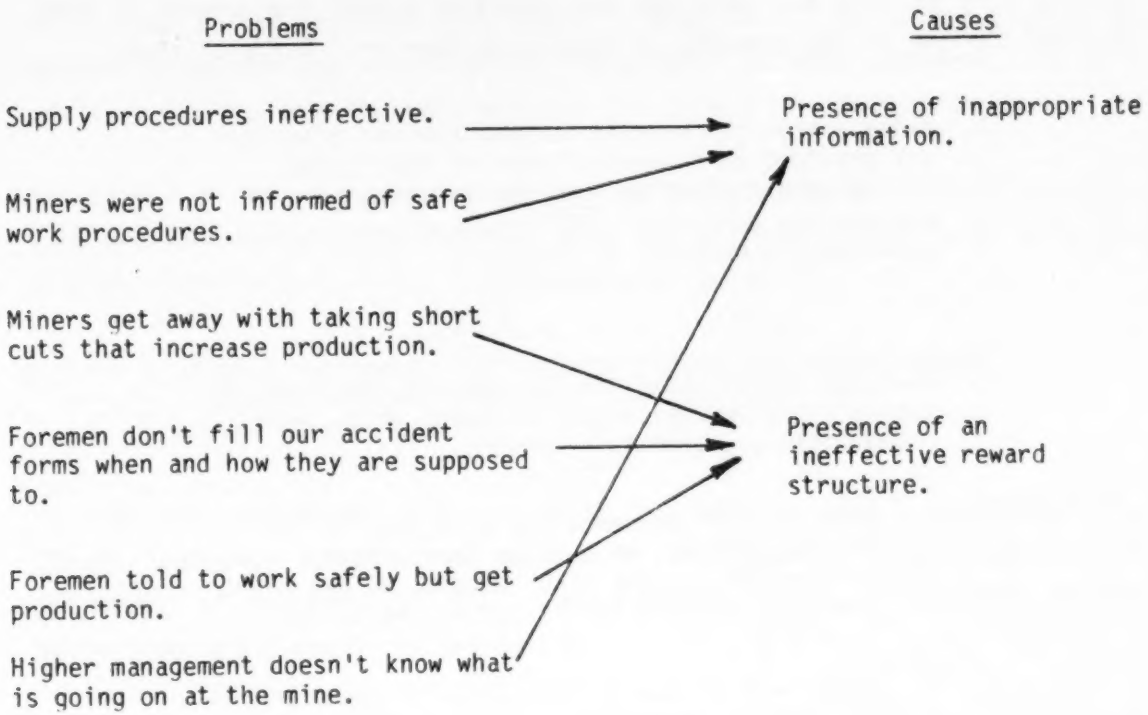
Once the problems are identified and supported by the interview and observational data, our next step is to determine which accidents resulted from the problem. We go back to our original accident data base and match the accidents to the problems. We are asking ourselves what accidents could have resulted from this problem. We are taking the information from "Column 3" and adding it to our lists in Columns #1 and #2.

Example Problem	Field Data	Accidents
Supply procedures ineffective.	"Face workers have stated ...	Shuttle cars operated with the first point burnt out. Resistor was not available. Operator lost control on rough ground.
	Everyone expects everything now."	

At the end of this step we will have supported, with data, the problems we have identified. We should have matched most of our accident data to the problems. What if we have a problem for which we have no accidents? It could be that the problem has no safety implications, that we have misinterpreted our accident data or have missed gathering some field data. However, we are interested in making a strong case. Even with some loose ends we should still have enough information to make our case.

We are now ready to go to "Column 4", Causes. Our problem statements will more than likely fall into groups which have the same cause. It is also very likely that the potential causes we discovered through the PBA and HBA will have been verified. In that case they are no longer potential.

For example:


Problems
Causes
Supply procedures ineffective.
Miners were not informed of safe work procedures.
Miners get away with taking short cuts that increase production.
Foremen don't fill our accident forms when and how they are supposed to.
Foremen told to work safely but get production.
Higher management doesn't know what is going on at the mine.
Presence of inappropriate information.
Presence of an ineffective reward structure.

Each of the problems listed in our example would have been supported by field and accident data. The problems listed have either of two causes, a faulty reward system or a lack of information.

As you recall, the purpose of the HBA and PBA was to help us narrow our investigation at the mine to specific aspects of the mining operation rather than the entire operation. Our organization of information is more than just a mechanical step. It permits us to isolate the causes of problems and accidents so that the operator can better utilize his/her efforts to eliminate causes having the greatest impact.

Having isolated the causes, now leads us to "Column 5", Recommendations. From our past experience, knowing things that have been done successfully, knowing actions that didn't work, we are in a position to "advise" the operator on what actions may be appropriate. While we cannot tell you what specific actions should be taken because you will be developing customized recommendations, we think the PBA and HBA can offer some guidance.

We have told you that accidents are the result of either the absence of some physical barrier or the presence of some human barrier. Rules of thumb:

1. Where a physical barrier is possible and practical not provided or a physical barrier has failed, the appropriate action must involve some type of engineering solution. That physical barrier must be provided, maintained, or created.

2. Where we have a human barrier present, the type of barrier provides the essential point which any recommended solution must address.

   A. Where lack of guidance and direction is the barrier, methods of getting the correct information, to the right people, at the right time must be part of the corrective actions.

   B. Where lack of appropriate tools or equipment is the barrier, corrective action must include procedures for determining and providing the appropriate tools and equipment or redesigning the job.

   C. Where the barrier is the lack of the appropriate reward structure or the punishment of appropriate behavior, the solution must involve the manipulation of the reward structure.

   D. Where the barrier is lack of knowledge, the corrective action must involve some sort of effective training.

   E. Where the barrier is a physical condition or impairment which results in the task exceeding the capacity of the individual, the specific physical condition of impairment must be defined and specifically addressed in the recommendation.

If these rules of thumb are used, our recommendations will not only be more likely to eliminate the cause of the problems, but applying the correct solutions will be much less costly for the operator.

We have now put all five columns together. We have the problems and the field and accident data which supports them. We know the causes of the problems and the requirements of the recommendations. At this point we need to go back to our original "Mad Model." When we filled in the blanks, we said we could come out with something meaningful or sheer nonsense. At this point we want to do a backward analysis for each of our recommendations.

Starting with one of the causes we have isolated, we go to the problem list. Each problem was supported by field data and accident data. Using only the accident information and our recommendations, we ask --

> If this recommendation had been implemented before these accidents occurred, would the accidents have been prevented or the possibility of their occurrence reduced?

We hope that the answer is yes. We do not want to make a recommendation, though logically sound, that would have no impact on the reduction or prevention of accidents at that mine. If our answer is no, then we had better make a different recommendation.

If we are satisfied that our recommendations would have prevented or reduced the likelihood of those past accidents, then we can safely assume our recommendations, if implemented, would prevent or reduce the likelihood of those kinds of accidents in the future.

We have previously mentioned that it was not our goal to manage the operation. While we can make recommendations that we are confident in, the operator must do the implementation. That leads us to a final consideration-

Are our recommendations reasonable?

We do not wish to make a recommendation which is so unreasonable that it would be unlikely the operator would ever implement it.

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		Laborer/Utility M/NM Pumper	Machinery	Running cut off saw and got something in left eye.
	Yes	Hand Tools (Powered)	Pulverized Mineral (Dust)	
	M	Mill/Prep Plants, etc.	Dust in eyes	
	30	Bitumin-Coal (Bituminous)	Eye(s)-Optic Nerve & Vision	
	3	Handtool-Powered(Drill)	Not Reported *******	
	5	******* 0002 0000 0000	1Y 0W 1Y 0W 13	
		Motorman/Swamper/ Switchman	Electrical	While unloading a mine car of crib blocks, at supply track in West Mains Section Near 1 South Belt Starter Victim, Apparently came in contact with 550 volt D.C. Trolley Line.
	Yes	Handl Supply, Mtrl, Load/Unl	Condctr, Elct, CBL, Trol, Pol	
	M	Other Underground	Elect Shock, Electrocution	
	28	Bitumin-Coal (Bituminous)	Body System-Poison, Nerve	
	1	Mine Car, Tmbr Trk, NIP-UG	Not Reported	
	31	Cont Miner		
		0000 0000 6000	3Y12W 0Y28W 3Y12W 1	
		Labr/Mck Mch Opr/Pipe Gin	Hand Tools (Not Elec, Air)	At the time of the accident a continuous length of 60IB rails was raised by means of lifting jack and Mr. I was removing blocks from underneath the rails he had placed his right foot under the rails when the jack slipped causing bruises of the tendons of his right foot.
	Yes	Handl Suply,Mtrl,Load/ Unl	Steel Rail (All kinds)	
	M	Other Underground	Contusion, Bruise, Intac Skin	
	52	Bitumin-Coal (Bituminous)	Foot (Not Ankle or Toe)	
	3	Handtool-Not Powered, Wrench	Not Reported	
	24	Cont Miner		
		0008 0000 0000	0Y20W 0Y20W 35Y 0W 13	
		Shuttle Car Orp/Ram Car	Powered Haulage	while in transit to the portal bottom. The employee was seated in mantrip with right foot extended out of the mantrip and it was struck by a mounting bracket from crusher bit unit.
	Yes	Opr/Ride in/on Mantrip	Metal, Nec(Pipe, Wire, Nail	
	M	UG Not Defined	Fracture Chip	
	41	Bitumin-Coal (Bituminous)	Foot (Not Ankle or Toe)	
	3	Mancar, MTrip, Prsnl Carrier	Galis	
	1	Cont Miner		
		0019 0000 0000	9Y 0W 0Y 2W 9Y 0W 13	

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	Yes M 29 3 2	Shuttle Car Opr/Ram Car Opr/Rid in/on Mantrip Other Underground Bitumin-Coal (Bituminous) Mancar, MTrip, Prsnl Carier Cont Miner 0008 0000 0000	Powered Haulage Mine Jeep, Kersey, Jitney Fracture, Chip Jaw, Chin Not Reported 5Y 4W 4Y 1W 5Y 4W 13	While riding in a mantrip on Bottom the mantrip went into a switch which was thrown against them and his head struck the side of the bus.
	Yes M 28 3 21	Motorman/Swamper Switchman Couple/Uncpl MN Car, Tract Other Underground Bitum-Coal (Bituminous) Mine car, Timbr, Trk, NIP-UG Cont Miner 0057 0000 0000	Handling Materials Chain, Rope, Cable-NT Convy Contusn, Bruise, Intac Skin Hand (Not Wrist or Finger) Not Reported 5Y OW 1Y32W 5Y OW 13	While switching out a supply car from entries, victim was removing a chain from the coupler of the supply car when his hand was pinched between chain and coupler as his buddy pulled on.
	Yes F 21 3 7	Laborer/Adv FC/MVUP/ Pupmn Roof Bolt, Nec Face (UG) Bitum-Coal (Bituminous) Rock Roof Bolting Machine, Cont. Miner 0022 0000 0000	Machinery Underground Mining Machines Fracture, Chip Finger(s) Galis 320 0Y28W 0Y 2W 0Y28W 13	While removing roof bolts from a bolting machine opr back machine up running over victims foot causing fractured toe.
	Yes M 39 3	Laborer/Adv FC/Mvup/ Pupmn Roof Bolter, Nec Face (UG) Bitum-Coal (Bituminous) Rock, Roof Bolting Machine Cont Miner 0018 0000 0000	Machinery Back Mine Roof, Hnging Wall Fracture, Chip Finger(s) Not reported 10Y OW BY OW 10Y OW 13	While victim was straightening out drill plank on roof bolt, the bolter opr pressurized the boom pinching and fracturing left middle finger.
	Yes M 39 3 31	Mechanic/Repairman Mach Main/Repair Face (UG) Bitum-Coal (Bituminous) Rock, Roof Bolting Machine Cont Miner 0011 0000 0000	Electrical Condctr, Elct, CBL, Trol Pol Elect Shock, Electrocution Body System-Poison, Nerve 10Y OW BY OW 10Y OW 13 Galis 32016858 10Y OW BY OW 10Y OW 13	While leaning against the Bolting Machine in 1BT-19F, the cable went to ground energizing the machine and victim received an electrical shock.

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		Motorman/Swamper/ Switchman	Powered Haulage	The man was riding in an 8 ton haulage motor when it derailed and stopped suddenly the sudden stop caused him to slide forward off the seat and strick his right wrist against the framework of the motor inside the operators cab the injury resulted in a fracture of the right wrist.
	Yes	Travel-To/From Work	Naro G Rail Cr, Mtr-UG Eqp	
	M	Location		
	65	Other Underground	Fracture, Chip	
		Bitumin-Coal (Bituminous)	Wrist	
	3	Locomotive-Rail Mounted	Not Reported	
	2	Cont Miner 0059 0000 0000	17Y OW 11Y OW 17Y OW 13	
		Wireman/Comm Repairman	Powered Haulage	While employee was releasing brake handle on #2 motor he pinched his little finger between the brake handle and the frame of machine accident occurred in 21 face run around.
	Yes	Opr Locomotive	NARO G Rail CR, MTR-UG Eqp	
	M	Other Underground	Fracture, Chip	
	27	Bitumin-Coal (Bituminous)	Finger(s)	
	6	Hydraulic Jets	Not Reported	
	24	(Monitors) Cont Miner 0000 0000 0000	0Y40W 0Y12W 7Y32W 13	
		Mechanic/Repairman	Handling Materials	The man was tightening a gear case on the 1 South Crusher when his right hand small finger was pinched between gear case and the frame of tail piece the injury was a fractured small finger right.
	Yes	Mach Maintenance/Repair	Metal, NEC (Pipe, Wire, Nail)	
	M	Other Underground	Fracture, Chip	
	41	Bitumin-Coal (Bituminous)	Finger(s)	
	6	Crusher, Breaker, Mill	Not Reported	
	21	Cont Miner 0000 0000 0000	3Y OW 1Y36W 3Y OW 13	
		Roof Bolter/Rock Bolter	Handling Materials	Canopy broke on left side and hit him on the top of the head.
	Yes	Unknown	Metal Covers & Guards	
	M	Face (UG)	Concussion-Brain, Cerebral	
	23	Bitumin-Coal (Bituminous)	Head, Nec	
	3	**********	**********	
	4	Cont Miner 0036 0000 0000	3Y OW 0Y13W 3Y OW 13	

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	Yes M 3 17	Oiler/Greaser Handl Suply, Mtrl, Load/Unl Strip/Open Pit Bitumin-Coal (Bituminous) Shovel Dragline, Power Shovel ****** 0000 0000 0000	Slip/Fall of Person Surface Mining Machines Contusion, Bruise, Intac Skin Knee Marion 191M 9Y OW 4Y OW 9Y OW 2	While carrying a 50 lb. bag of floor dry on the 191 shovel tripped on a hose laying on the floor thus falling and hitting my left knee on the floor.
	Yes M 31 3 40	Mechanic/Repairman Mach Maintenance/Repair Strip/Open Pit Bitumin-Coal (Bituminous) Welding Machine *****0002 0000 0000	Machinery Machine, NEC-Weldr,OFC MAC Elec.Arc Burn-Not Contac Eye(s)-Optic Nrve & Vision Not on List OY 9W 10Y OW OY 9W 13	Working next to welder cutting dump rope and got flash burn.
	Yes M 51 3 2	Hghlft Opr/Frntnd Ldr Opr Scraper (Rig), Cans, etc. Strip/Open Pit Bitumin-Coal (Bituminous) Scraper Lodr, Tractr Scrap *****0016 0000 0000	Powered Haulage Surface Mining Machines Unclassified Not Determined Multiple Major Body Parts Terex 75-24 6Y26W 6Y26W 6Y26W 2	Passing scraper on a turn lost control and rolled scraper over bank.
	Yes M 48 3 16	Welder Walking/Running Strip/Open Pit Bitumin-Coal (Bituminous) Shovel, Dragline, Power Shovel *****0005 0000 0000	Slip/Fall of person Floor, Walking Surf-Not UG Unclassified, not determined Knee Bycyrus-Erie #1370 6Y OW 6Y OW 6Y OW 13	Stepped into an open manhole leading to the revolving frame, hurt right knee.

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MINE ID FOFC CNTY STATE IDATE DOCUMENT# CLOS DOC#	CTR CMP SEX AGE DEG AT	OCCUPATION TITLE ACTIVITY OF INJURED LOCATION OF ACCIDENT CANVASS COMMODITY MINING MACHINE UG MNEMTH DAW DRSA DRSA	ACCIDENT CLASSIFICATION SOURCE OF INJURY NATURE OF INJURY PART OF BODY INJURED MANUFACTURER MODEL # MN EXP OB EXP TO EXP PTB	NARRATIVE DESCRIPTION OF ACCIDENT AND INJURY AS CONTAINED ON THE ACC/INJ FORM (FORM 7000-1)
		Labr Foremn/Bulgng Foremn	Fall of Face Caving Rock, Coal, Ore, Waste	The man was standing in a crosscut when a piece of rib fell out and struck the back of his left ankle. The piece of coal measured three feet long, two feet wide, and one foot thick. the injury consists of torn ligaments in his left ankle
	Yes	Idle (Eat Lunch, Breakfast, etc.)	Sprain, strain ruptured disc, ankle	
	M	Other Underground		
		Bitumin-Coal (Bituminous)		
	3	**********	********** **********	
		Mechanic/Repairman	Handling Materials	Removing a door off #4221 drill rig, the door fell and bent right thumb back.
	Yes	Mach Maintenance/Repair	Metal Covers & Guards	
	M	Strip/Open Pit	Sprain, Strain Rupt Disc	
	44	Bitumin-Coal (Bituminous)	Finger(s)	
	3	Rock Drill, Jackleg, Airleg	Robbins #421	
	4	******0015 0000 0000	9Y OW 19Y OW 9Y OW 2	
		Electrician	Powered Haulage	The conveyor chain broke on feeder employee was trying to get the chain untangled feeder was turned on to reverse the conveyor employees hand got tangled in chain and was pulled into set of gears.
	Yes	Mach Maintenance/Repair	Belt Conveyors	
	M	Face (UG)	Amputation of Enucleation	
	29	Bitumin-Coal (Bituminous)	Finger(s)	
	2	Conveyor	Stamler *********	
	20	Cont Miner		
		0000 0000 1140	4Y OW 3Y OW 4Y OW 13	
		Mechanic/Repairman	Handling Materials	Employee opened lid of tool box and lid fell on both hands.
	Yes	Handl Suply, Mtrl, Load/Unl	Boxes, Crates, Cartons	
	M	Face (UG)	Contusn, Bruise, Intac Skin	
	21	Bitumin-Coal (Bituminous)	Wrist	
	6	**********	********** **********	
	4	Cont Miner		
		0000 0000 0000	2Y26W OY34W 2Y26W 13	

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		Laborer/AdV FC/MVUP/ PUPMN	Striking/Bumping	Tucker was carrying timber through curtain and bumped into a strap header that was uneven with the roof.
	Yes	Handling Timber	Posts, Caps, Headers, Timber	
	M	Face (UG)	Contusn, Bruise, Intac Skin	
	22	Bitumin-Coal (Bituminous)	Shoulder(s)	
	3	*******	********* **********	
	1	Cont Miner		
		0003 0000 0000	1Y17W 1Y17W 1Y17W 13	
		Belt/Conveyor Man	Powered Haulage	Man was crossing belt when belt came on throwing him on belt. Caught upper right arm on roller.
	Yes	Get(on, off) Equip, Mach, etc.	Belt Conveyors	
	M	Other Underground	Cut, Lacer, Punct-Opn Wound	
	31	Bitumin-Coal (Bituminous)	Upper Arm	
	3	Conveyor	Not Reported	
	8	****0003 0000 0000	2Y 0W 0Y 8W 0W 13	
		Electrician	Handling Materials	Employee bumped his left leg on the brake lever while getting out on mantrip.
	Yes	Get (on,Off) Equip, Mach, etc.	Mine Jeep, Kersey, Jitney	
	M	Other Underground	Fracture, Chip	
	28	Bitumin-Coal (Bituminous)	Leg, Nec	
	3	Mancar, Mtrip, Prsnl Carier	Not Reported	
	1	******* 0040 0000 0000	6Y 0W 0Y 0W 9Y 0W 13	
		Roof Bolter/Rock Bolter	Machinery	Injured was positioning left head of Fletcher Roof Bolter next to the rib when he caught his right hand between the rib and the control levers.
	Yes	Roof Bolter, NEC	Side or Rib	
	M	Face (UG)	Crushing	
	22	Bitumin-Coal (Bituminous)	Finger(s)	
	3	Roof, Roof Bolting Machine	Fletcher *******	
	24	Cont Miner		
		0053 0000 0000	3Y26W 1Y26W 3Y26W 13	

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Yes	M	Tmermn/Propmn/Jckstr	Falling, Sliding, Rolling Rock	Rock hit him in left eye when walking by men working breaking rock.
	37	Walking/Running	Broken Rock, Coal, Ore, Waste	
		Face (UG)	Contusion, Bruise, Intac Skin	
		Bitumin-Coal (Bitmininous)	Eye(s)-Optic Nerve & Vision	
	3	**********	********** **********	
	5	Longwall 0007 0000 0000	6Y 0W 6Y 0W 6Y 0W 13	
Yes	M	Section Foreman/ Shift Boss	Handling Materials	Helping electrician splice cable and some corrosion was flipped in his eye.
	29	Handl Suply, Mtrl, Load/Unl	Chemicals, Chem Comp, Nec	
		Face (UG)	Burn, Chemical-Fume, Compound	
		Bitumin-Coal (Bituminous)	Eye(s)-Optic Nerve & Vision	
	3	**********	********** **********	
	8	Cont Miner		
		0015 0000 0000	2Y 0W 6Y 0W 9Y22W 13	
Yes	M	Scoop Car/Operator Unitrac Operator	Machinery	Putting up bolt was lining pinner up to bolt and hit wrong lever closing drill steel clamb on his finger.
	23	Roof Bolter, Inserting Bolt	Underground Mining Machines	
		Face (UG)	Contusion, Bruise, Intac Skin	
		Bitumin-Coal (Bituminous)	Finger(s)	
	3	Rock, Roof Bolting Machine	Lee-Norse **********	
	24	Cont Miner		
		0003 0000 0000	1Y13W 3Y 0W 5Y26W 13	
Yes	M	Welder	Inundation	Billy was welding and cutting zinc galvanized tubing for main fan installation for 20 Mine he worked two days at this then became sick dizzy and sleepy from fumes this was outside at 20 Mine.
	55	Ventilation (Mant/ Install)	Chemicals, Chem Comp, Nec	
		Surf at Underground Mine	Other Injury, Nec	
		Bitumin-Coal (Bituminous)	Chest-Rib, Breast Bone	
	3	Welding Machine	Not Reported ******	
	36	********0012 0000 0000	5Y42W 5Y42W 5Y42W 13	

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		Shuttle Car Opr/ Ram Car	Powered Haulage	Employee was putting rock dust into rock dust machine when the flat car it was riding on passed under th return overcast and employee got his arm caught between the top of the rock duster and the overcast.
	Yes	Ride Equipment	Cement Prod, Concrete Block	
	M	Other Underground	Contusion, Bruise, Intac Skin	
	23	Bitumin-Coal (Bituminous)	Arm, Nec	
	3	Rock Dusting Machine	Not Reported *********	
	21	******** 0000 0000 0000	1 Y 9W 0Y35W 2Y 0W 13	
		Scoop Car Opr/ Unitrac Opr	Machinery	Employee was lowering the drill head of the Roof Bolter to remove the drill steel when his leg slipped on the wet bottom he was kneeling on and his foot went under the drill head as it came down and crushed his foot.
	Yes	Roof Bolter, Nec	Mine floor, Bottom, Footwall	
	M	Face (UG)	Fracture, Chip	
	31	Bitumin-Coal (Bituminous)	Foot (Not Ankle or Toe)	
	3	Rock, Roof Bolting	Lee-Norse	
	21	Machine Cont Miner 0000 0000 0000	1Y26W 1Y 0W 5Y 0W 13	
		Continuous Miner Helper	Powered Haulage	Was hooking rock dust car to motor. Motor bumped car it came down track and hit right hand.
	Yes	Couple/Uncpl MN Car,	Naro G Rail CR, Mtr-UG Eqp	
	M	Other Underground	Fracture, Chip	
	26	Bitumin-Coal (Bituminous)	Hand (Not Wrist or Finger)	
	3	Locomotive-Rail Mounted	Jefrey-Dresr MH110	
	7	Cont Miner 0002 0000 0000	0Y30W 10Y 0W 10Y 0W 13	
		Bulldozer Opr/Tractor/ Hvy E	Handling Materials	Employee was getting on rubber tired dozer when he shut the door on his thumb.
	Yes	Get (On, Off) Equip, Mach, etc.	Metal Covers & Guards	
	M	Strip/Open Pit	Fracture, Chip	
	43	Bitumin-Coal (Bituminous)	Finger(s)	
	3	Bulldozer, Dozer, Crawler, Tractor	Caterpillar	
	7	****** 0021 0000 0000	3Y 0W 15Y 0W 18Y 0W 13	

TRAINING CENTER

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	R59 Yes M 19 3 20	Oiler/Greaser Clean Up Strip/Open Pit Bitumin-Coal (Bituminous) Conveyor *****0000 0000 0000	Powered Haulage Conveyors, Nec Unclassified, Not Determined Arm, Nec Not on List 0Y35W 0Y35W 0Y35W 2	While trying to clean tail with a shovel conv. belt grabbed shovel and pulled Mr. Burns left arm into tail roll.
	Yes M 36 3 31	Welder Hand Tools (Nonpowered) Strip/Open Pit Bitumin-Coal (Bituminous) Welding Machine ****** 0003 0000 0000	Electrical Machine, Nec-Weldr, Ofc Mac Electric Burn-Cntact Burn Upper Extremity, Multiple Not on List ********** 0Y 3W 10Y 0W 0Y 3W 2	Was using an Allen Wrench to put welding gun on wire feeder and it shorted out and burned fingers, hand.
	Yes M 29 3 39	Electrician Elec Maintenance/Repair Strip/Open Pit Bitumin-Coal (Bituminous) Machine, Nec ******* 0002 0000 0000	Machinery Surface Mining Machines Elec. Arc Burn-Not Contac Eye(s)-Optic Nrve & Vision Not on List ********* 4Y 0W 4Y 0W 4Y 0W 2	Working on Byrd Machine and received a flash to eyes when small oil pump starter was pulled in.
	Yes M 49 3 4	Welder Handl Suply, Mtrl, Load/Unl Mill/Prep Plants, etc. Bitumin-Coal (Bituminous) Bulldozer, Dozr, Crawler, Tractor ******* 0003 0000 0000	Handling Materials Metal, Nec (Pipe, Wire, Nail) Contusn, bruise, intac skin Foot (Not Ankle or Toe) Caterpillar D-9 Pad 2Y 0W 20Y 0W 2Y 0W 2	Was stacking track pads stack shifted causing pads to fall causing one to land on right foot.
	Yes M 28 3 8	Oiler/Greaser Handl Suply, Mtrl, Load/Unl Mill/Prep Plants, etc. Bitumin-Coal (Bituminous) ********** ******* 0002 0000 0000	Handling Materials Metal, Nec (Pipe, Wire, Nail) Contusn, Bruise, Intac Skin Ankle ********** ********** 2Y 0W 1Y 0W 2Y 0W 2	Loading a barrel of solvent into a pickup when the ramp from dock to the pickup flipped up and hit his right ankle.

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	Yes M 32 3 8	Mechanic/Repairman Mach Maintenance/Repair Mill/Prep Plants, etc. Bitumin-Coal (Bituminous) Pump ****** 0011 0000 0000	Machinery Metal, Nec (Pipe, Wire, Nail) Fracture, Chip Finger(s) Not on List ********** BY OW 2Y OW BY OW 2	Taking a bearing off a pump when the last bolt was removed the pressure blew hand against another pipe smashing left thumb.
	Yes M 33 3 1	Oiler/Greaser Mach Maintenance/Repair Mill/Prep Plants, etc. Bitumin-Coal (Bituminous) Ore Haulage/Off Highway Truck ****** 0002 0000 0000	Handling Materials Metal Covers and Guards Cut, Lacer, Punct-Opn Wound Finger(s) Euclid CH120 3Y OW 5Y OW 3Y OW 2	Cut finger while removing radiator cap from truck.
	Yes M 38 3 21	Mechanic/Repairman Mach Maintenance/Repair Strip/Open Pit Bitumin-Coal (Bituminous) ********** ****** 0009 0000 0000	Machinery Metal, Nec (Pipe, Wire, Nail) Cut, Lacer, Punct-Open Wound Hand (Not wrist or finger) ********** ********** 4Y OW 12Y OW 4Y OW 2	Removing Ejector Cylinder on Scraper pulled Low ER Pin out and cylinder swung forward on shop overhead crane came back and hit hand between cylinder and pin.
	Yes M 33 6 24	Mechanic/Repairman Mach Maintenance/Repair Other Underground Bitumin-Coal (Bituminous) Rock, Roof Bolting Machine Cont Miner 0000 0000 0000	Handling Materials Underground Mining Machine Fracture, Chip Finger(s) Not Reported ******* 2Y 4W 0Y45W 2Y 4W 13	While replacing a cover on the Fletcher Bolter in 1 South he caught his finger between the frame of the machine and the cover.
	Yes M 34 3 2	Truck Driver Opr Haulage Truck Strip/Open Pit Bitumin-Coal (Bituminous) Ore Haulage/Off Highway Truck ****** 0016 0000 0000	Powered Haulage Hghwy Ore, Carrier, Lrge Truck Multiple Injuries Multiple Major Body Parts Euclid R105 5Y OW 5Y OW 5Y OW 13	Lost control and rolled truck on side when he was coming off a hill to fast on a wet roadway.

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	Yes M 33 6 8	Pumper Hand Tools (Nonpowered) Other Underground Bitumin-Coal (Bituminous) Handtool-Not Powered, Wrench Cont Miner 0000 0000 0000	Hand Tools (Not Elec, Air) Knife Cut, Lacer, Punct-Opn Wound Hand (Not Wrist or Finger) Not Reported 6Y24W 3Y 0W 6Y24W 13	As victim was cutting insulation off of a pump ground wire the knife slipped and victim lacerated his left palm.
	Yes M 31 3 12	Welder Moving Equipment-Fan, Pump, Conveyor Mill/Prep Plants, etc. Bitumin-Coal (Bituminous) Trucks (Not Ore) Pickup, Watr ****** 0004 0000 0000	Slip/Fall of Person Ground Cut, Lacer, Punct-Opn Wound Face, Nec GMC 6x6 2Y 0W 4Y 0W 2Y 0W 2	Unloading Welding Machine slipped on oil on back up truck and fell to the ground.
	Yes M 59 6 8	Motorman, Swamper/ Switchman Hand, Reposit Tubing, Pipe Other Underground Bitumin-Coal (Bituminous) ********** Cont Miner 0000 0000 0000	Handling Materials Conductor, Elect, Cbl, Trol Pol Cut, Lacer, Punct-Opn Wound Head, Nec ********** ********** 30Y 0W 3Y 0W 43Y 0W 13	24 Butt Right - Victim Unrolling Trolley wire, end of wire sprung back striking victim on left side of head.
	Yes M 25 3 21	Jacksetter/Longwall Advancement Opr Longwall, Shear, Plow Face (UG) Bitumin-Coal (Bituminous) Longwall Subparts Longwall 0007 0000 0000	Machinery Longwall Supt, Jks & Chock Contusion, Bruise, Intac Skin Hip-Pelvis, Plvc Orgn, Butt Not Reported ********** 2Y 0W 0Y26W 2Y 0W 13	Put hand on rotary valve to let down chocks and he had it in the wrong notch and put pan line on himself.

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	Yes M 25 3 24	Laborer/Adv Fc/Mvup/ Pupmn Set/Remove/Relocate Props Face (UG) Bitumin-Coal (Bituminous) ********** Cont Miner 0000 0000 0000	Handling Materials Posts, Caps, Headers, Timber Fracture, Chip Finger(s) ********** ********** 4Y OW 4Y OW 4Y OW 13	3 Linemen were setting 6x6x14' timber in fall area. Mr. was putting a wedge under timber and did not get his fingers out from under timber before it was let down.
	Yes M 26 3 2	Belt/Conveyor Man Opr/Ride In/On Mantrip Other Underground Bitumin-Coal (Bituminous) Mancar, Mantrip, Prsnl Carier ****** 0006 0000 0000	Powered Haulage Mine Jeep, Kersey, Jitney Contusion, Bruise, Intac Skin Knee Not Reported 4Y OW 4Y OW 5Y OW 13	Mantrip bumped parked trip at mount of 5 West Section. Man bumped knees on front of portal bus.
	Yes M 27 3 4	Labr/Mck Mch Opr/ Pipe Gin Mach Maintenance/ Repair Other Underground Bitumin-Coal (Bituminous) Conveyor ****** 0001 0000 0000	Powered Haulage Wood Items, Nec Contusion, Bruise, Intac Skin Ankle Not Reported ******** 0Y26W 0Y17W 0Y30W 13	Was making belt splice belt switch was not tagged out. Foreman came along and started belts and splice board struck beltman on ankle.

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